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Advisory Commission on State Emergency Communications

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October 21, 1997

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Office of the Secretary
Federal Communications Commission
1919 M. Street, N.W., Room 222
Washington, D.C. 20554

RE: In the Matter of Revision of the Commission's Rules to Ensure Compatibility with Enhanced 911 Emergency Calling Systems; CC Docket No. 94-102.

Dear Commission Secretary:

The Texas Advisory Commission on State Emergency Communications ("TX-ACSEC") indicated in its reply comments to the requests for reconsideration that it would file a copy of its "Wireless Integration Project" (WIP) report with the Commission upon its final completion. Pursuant to § 1.1206, TX-ACSEC submits two copies of the WIP report as an ex parte presentation.

Thank you for your attention in this matter.

Sincerely,

Richard A. Muscat
Director, Regulatory Affairs
State Bar No. 14641550

RAM/mjb

cc: James Hobson, National Emergency Number Association

Enclosures

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9-1-1

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Wireless Integration Project

Texas 9-1-1 Professionals from
Government
Industry
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A Report to the
Advisory Commission on State Emergency Communications
State of Texas

Texas Wireless Integration Project

Final Documentation

May 1997

FOREWARD

Since the 1968 Presidential Commission established 9-1-1 as the national emergency number for access to emergency services, telecommunications has evolved to permit 9-1-1 calls the capability to deliver features specific to the caller's location - the telephone number and physical location. These features have been essential to the successful operation of 9-1-1 services. This success has also created a service level expectation for the citizenry.

As the telecommunications industry continues to evolve the 9-1-1 community must plan and implement new technologies that protect the base of 9-1-1. Without the essential call back telephone number and location information of a caller, the 9-1-1 system will fail to meet the expectations of the public. What appears to be common place in the processing of 9-1-1 calls, ANI and ALI, is actually losing ground. The continued growth of wireless technology is phenomenal but is disastrous to 9-1-1.

The Federal Communications Commission is requiring a solution with 94-102. This solution requires the wireline, wireless, and 9-1-1 community to work collectively toward a viable answer to protect 9-1-1 as we know it today and to allow for further enhancements, such as a graphical display of location information.

This document provides a detailed explanation of a trial conducted in Houston, Texas, by a group of individuals who cared about 9-1-1, had a vision for a solution, and implemented it! The Wireless Integration Projection or WIP, as it is known, was a true collective partnership between the industries and the 9-1-1 community that actually exceeded the FCC mandates.

Texas Wireless Integration Project

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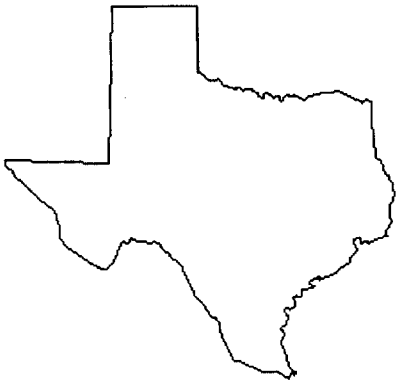
Appendices

- Glossary of Terms
- WIP in Houston - GTE Telops Independent Project Evaluation
- Project Plan Summaries
  - Phase I
  - Phase II
- FCC Docket No 94-102



Wireless Integration Project

Texas 9-1-1 Professionals from
Government
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Telecommunications

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Final Documentation
May 1997

Texas Wireless Integration Project

In May, 1995, Greater Harris County 9-1-1 Emergency Network and Tarrant County 9-1-1 District joined together to propose a research study to the Advisory Commission on State Emergency Communications. The objectives of the study were:

1 to prove that technology exists to provide both automatic number identification (ANI) and automatic location identification (ALI) for the majority of wireless 9-1-1 calls

2 to evaluate existing, emerging, and future technology needs to integrate wireless telecommunications technology into the mainstream 9-1-1 environment

3 to influence industry standards and encourage rapid development and deployment of standards relating to wireless 9-1-1 data delivery

4 to validate approaches and tools available for any dial tone or network service provider, including wireless, RMTS, fiber, cable, satellite, or other future systems

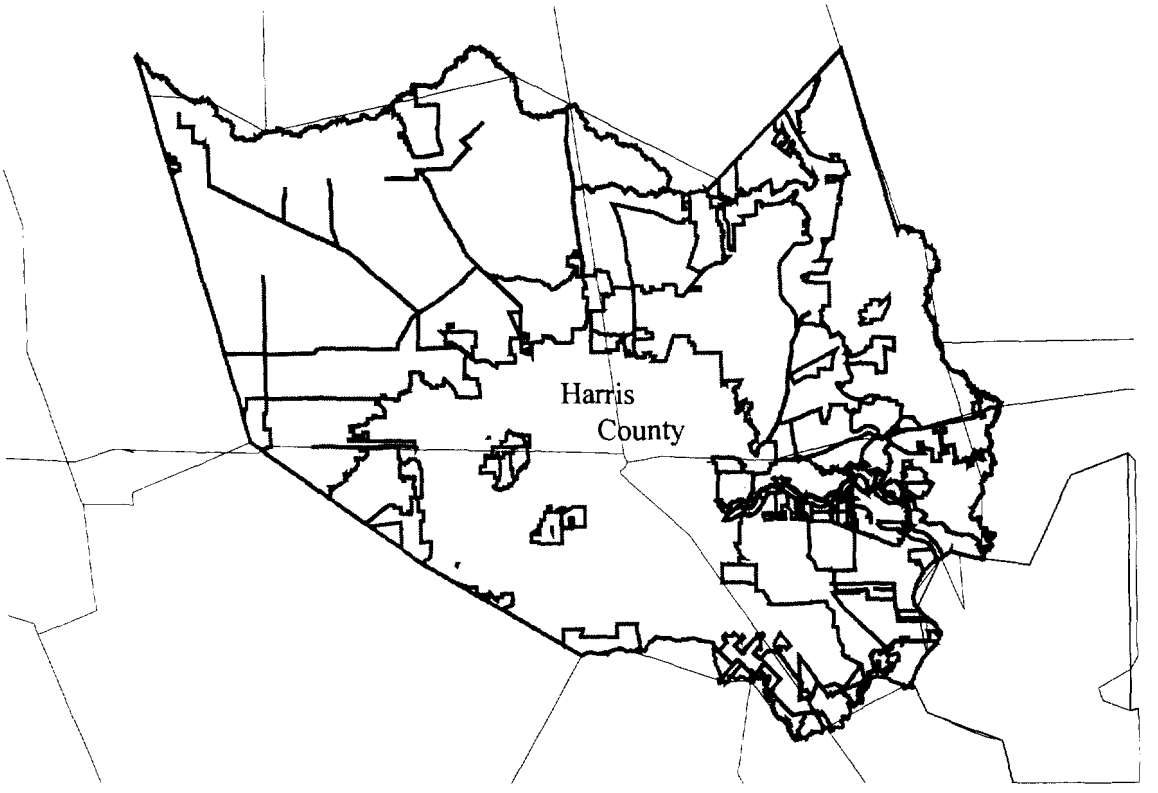
Partners in this joint effort included the two 9-1-1 districts and the State 9-1-1 Advisory Commission, along with an impressive team of industry partners including NORTEL, Southwestern Bell, GTE, SCC, and Associated Group, Inc. Additionally, GTE Mobilnet (Phase I demonstration) and Houston Cellular (Phase II demonstration) were team participants. Funding was provided by all of the team members as well as the ACSEC to complete the research effort.

WIP TEAM MEMBERS

Greater Harris County 9-1-1 Network	John Melcher
Tarrant County 9-1-1 District	Beth Ozanich
Advisory Commission on State Emergency Communications	Carey Spence
NORTEL	Derek Prada, Chris Ouellette
Southwestern Bell Corporation	Cindy Clugy, Ron Mathis, Ben Mahaffey
GTE Telephone Operations	Russ Russell
SCC Communications Corp	Eric Sorensen
Associated Group, Inc.	Louis A. Stilp
GTE MobilNet	Cassandra Johnson
Houston Cellular	Theresa Graham

This report documents the Wireless Integration Project (WIP) and provides detail on each of the components developed to complete the three phases identified by the Team. Phases are described in this section, followed by detailed documentation for the project. Prior to the commencement of the testing, the team identified service level features that may serve as a basis for identifying components for the provision of Wireless 9-1-1 service levels. This document is included as a prelude to the WIP Phase descriptions.

FCC 94-102 Report & Order in the matter of Revision of the Commission's Rules To Ensure Compatibility with Enhanced 911 Emergency Calling Systems was released on July 26, 1996. In summary, it stated that wireless carriers must take action to deliver data identifying caller ANI and location in two phases. The first phase requires that carriers take steps to enable that caller ANI be delivered to PSAPs within twelve months of the date of the order and that within eighteen months of the date of the order, these delivery systems must be in place. The second Phase requires that caller location be determined and delivered to the PSAP within five years from the date of the order. The effective date of the order is October 1, 1996. The order states that PSAPs must request that carriers comply with the Report and Order and that those PSAPs must be capable of receiving and using the data being delivered. The reader may obtain copies of the final Report and Order through the FCC's home page subsequent to publication of this document. A copy of the full text of the Report and Order and Further Notice of Proposed Rulemaking (dated July 26, 1996) is included in this document as Appendix I. **[www.fcc.gov/bureaus/wireless/orders/fcc96264.txt]**



Project Summary

Phase I

In Phase I, the objective was to deliver call-back ANI along with the cellular tower location, providing the call-taker with a graphic display of the cell tower coverage area. The goal was to provide a real call back telephone number and at least a "fuzzy" location of the caller's general vicinity, which could be refined in a manual mode between the caller and the call taker. Test calls were placed using a controlled test number (2-1-1) and within a limited calling area. Data delivery included the ten digit mobile caller identification number (MIN), a pseudo ANI used to tie the cellular tower face to the call and to data specific to the tower face for map display of the radio frequency coverage area of the tower. Harris County received the test calls in their telecommunications laboratory at two separate workstations, simulating delivery to two different PSAPs.

Phase II

In Phase II, a more accurate identification of the caller's location was determined using location determination technology. Dynamic call routing and setup were deployed to pass the resulting data through the telephone network to the PSAP. Actual routing of the call was based upon caller ANI, not on the pseudo ANI of the tower receiving the call. Details of this process are provided in this documentation. The test allowed for delivery of the caller's call-back telephone number, the pseudo ANI for default routing of the call in the event that a location could not be determined, and the actual coordinate location of the caller derived through the use of a location determination technology (LDT). This test was conducted in the Harris County telecommunications laboratory, simulating two PSAP delivery points, one employing Primary Rate Interface (PRI) and one with Multi Frequency signaling (MF). Calls were also sent to the Village PSAP, a working public safety answering point.

Several other activities, described in detail further on in this document, were also performed. These include spatial rectification of the base map used for call location displays, a survey of location determination technology and description of methods in Beta test mode, development and testing of protocol framework for LDT data transmission, coordination and communication with standards development groups such as CTIA, TIA, PCIA, NENA, APCO, and NASNA. Appendices to this document provide details on these activities.

Other Trials

Documentation of trials in Washington State and along the New Jersey Turnpike are included, with permission in this report. The Washington State trial demonstrated one method for reaching compliance with the FCC's Phase I requirements. The New Jersey trial demonstrated a method for Phase II compliance. Both of these trials used different methods for reaching the states Phase I and II goals than were applied in the Texas trial. The Texas Wireless Integration Project Team agreed that the importance of including as much empirical evidence relative to successful application of existing technologies in reaching the FCC's mandates would be of major benefit to the 9-1-1 community at large. While this report does not provide solutions for every conceivable situation, it provides a framework and base line from which to proceed in accomplishing the eventual deployment of systems to deliver caller telephone numbers and location information for 9-1-1 calls placed from wireless devices.

The Washington State trial employed the public telephone network with required data transmission alterations and PSAP CPE modifications, to deliver ten digit call-back ANI to the PSAP. This activity, which coincides with the FCC's phase I description, is documented as a parallel to the WIP Project's first phase in this report. The critical importance of the Washington trial comes from the reality of extensive infrastructure investment throughout the country and the economic reality that all PSAPs cannot change out their present equipment in the immediate future. Minor modifications of the public network were exercised in the Washington trial to accomplish the task of delivery of caller ANI to the PSAP. The Washington trial demonstrated a solution within a commonly found 9-1-1 network environment, rather than in the specialized network found in Harris County, moving the test out of the controlled setting and into the public telephone network using a working DMS100 switch and modification of installed desktop CPE.

The New Jersey Trial demonstrated Phase II feasibility and was conducted in a live 9-1-1 environment, directing calls using dynamic call routing based on location information delivered from the LDT participant. The trial used Feature Group "D" connectivity to route calls to live PSAPs. In New Jersey, a Rockwell switch was employed for call handling activities.

WIP Phases I and II were largely reliant on the use of a privately maintained telecommunications network belonging to the Greater Harris County 9-1-1 Network. Lucent's 5Ess switch was used, with modifications described in this document.

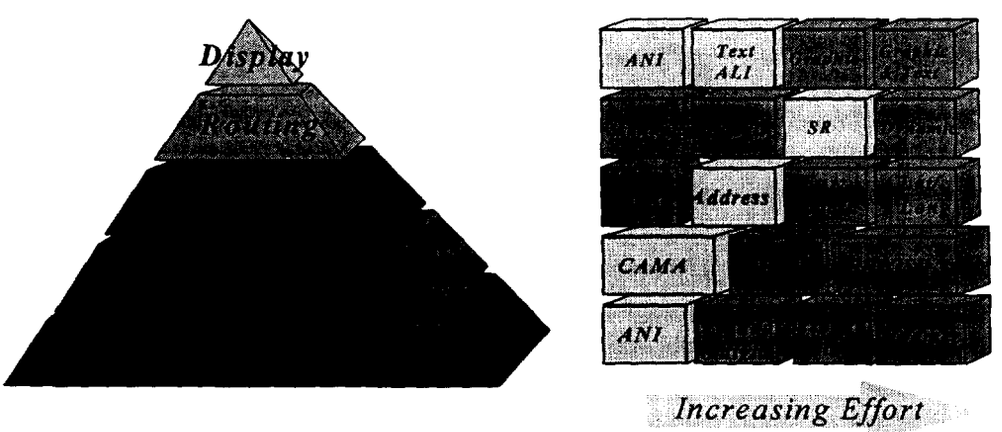
SERVICE LEVEL DESCRIPTIONS

Features have been defined in this document that serve as a basis for identifying components for the provision of Wireless 9-1-1 service levels. Costs, network capabilities, and local preferences will ultimately impact the final level of service that is to be established in any given area. This document serves as a common guideline for feature definitions as defined by this project.

To place the concept of 9-1-1 service levels into perspective, a new diagram has been developed to describe structure to the available choices that impact 9-1-1 delivery. These choices relate to funding levels, networks, expertise and require varying amounts of effort to deploy. Each of the elements identified in the boxes is explained in detail in the following section.

The first version of the diagram graphically depicts the typical enhanced 9-1-1 service offering. We describe the current E9-1-1 environment by highlighting the blocks that represent elements currently in use in most enhanced 9-1-1 systems throughout Texas. The current E-911 system delivers 8-digit ANI and text ALI, selectively routes calls, provides street address for location, and delivers ANI over CAMA trunks.

Service Level Building Blocks



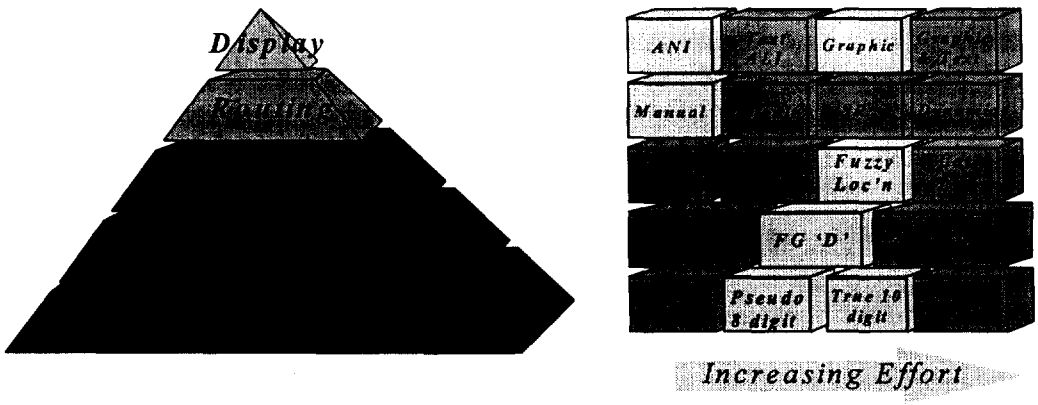
Wireline E-911

The Phase I objectives stated by the FCC include delivery of the caller's telephone number to the PSAP. This means that the PSAP needs to receive a dialable number that they can use to reliably reach the caller in the event that the connection is lost. The FCC's mandate states that within an 18 month time period, cellular carriers must

be able to deliver true ANI to the PSAP, assuming the PSAP can receive it and that they request it be sent. The WIP project added a locational element to its Phase I demonstration by establishing a pseudo ANI representative of the cellular tower location and radio frequency coverage area of each antenna on the various faces of the tower.

WIP's Phase I demonstration added the spatial aspect of the RF coverage area of each cell tower. We then demonstrated the display by predetermining polygons on our base map that represented those RF coverage areas. Repeating the diagram used to describe Wireline E-911, a different set of boxes is highlighted to illustrate the features demonstrated in WIP's Phase I demonstration. WIP Phase I demonstrated delivery of true caller ANI, using Feature Group "D", along with pseudo ANI to identify tower site and produce what we termed a "fuzzy" location. We used manual transfer capabilities, but some selectivity is possible. The display was caller ANI plus a graphic of the radio frequency coverage area for the tower face that carried the call to the network.

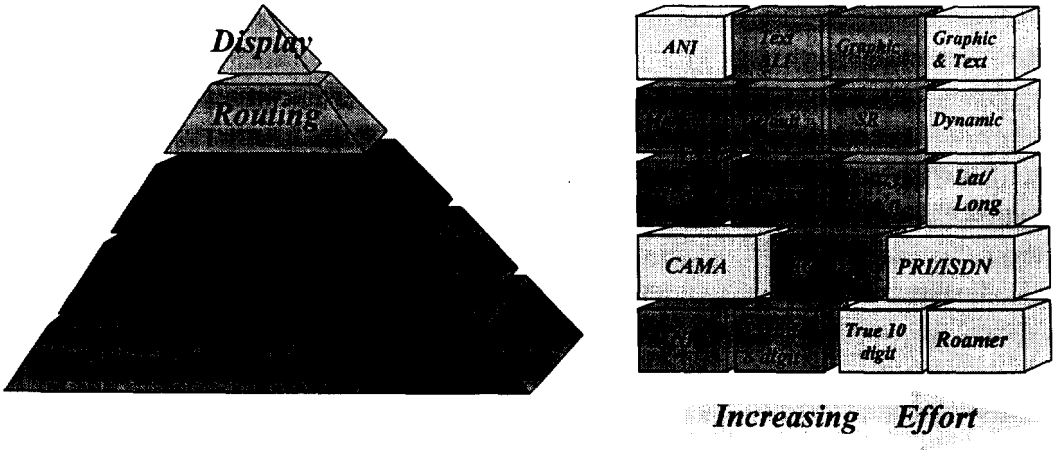
Service Level Building Blocks



Phase One Wireless 911

WIP's Phase II demonstration included the use of location determination technology, delivering the caller's actual coordinate location through the measurement of cell call radio signals. The block diagram illustrating features deployed for WIP's Phase II demonstration appears below. WIP Phase II delivered true 10-digit ANI over digital/intelligent network, applied LDT to measure signals and derive latitude/longitude; dynamic routing based on coordinate position (point-in-polygon). The display was true ANI plus a map display and a text message containing confidence the measurement and lat/long, which is another form of site address.

Service Level Building Blocks



Phase Two Wireless 911

SERVICE LEVEL ELEMENT DESCRIPTIONS

Having illustrated the choices made for deployment of WIP's Phase I and II demonstrations, each element identified within the wireless 9-1-1 delivery process is described in detail in the following section.

AUTOMATIC NUMBER IDENTIFICATION

Automatic Number Identification is the ability for the network to provide a telephone number associated with the calling party's telephone instrument. This number may be provided in various formats and represent differing types of information. However, the basic purpose of ANI in a wireless 9-1-1 environment is to provide the Public Safety Answering Point (PSAP) with a telephone number that can be used to reconnect with (call back) the calling party if the original call is terminated for some reason.

True ANI

True ANI is defined as the telephone number that is the assigned number for a wireless telephone device and is published or generally available to the public for accessing that specific device through the wireless network. A True ANI provides both area code (NPA) plus the exchange (NXX) and line number (i.e.(214) 555- xxxx). The method in which the NPA information is supplied may differ depending on the network technology employed to transport the information from the wireless network to the E9-1-1 network. The NPA may be specifically provided (a full ten digit ANI), a compressed NPA or NPD may be provided (eight digit ANI), or the NPA may be derived or assumed based on the incoming trunk group to the E9-1-1 system.

Roamer ANI

Roamer ANI is defined as a telephone number that is temporarily assigned to a wireless device that is roaming in the local wireless network system. This telephone number may or may not be useful to reconnect with a calling party if the original call is terminated. It does, however, generally follow the same format as a True ANI. The actual digit assignments may not follow generally accepted rules for NPAs and NXXs. The method in which the NPA information is supplied may differ depending on the network technology employed to transport the information from the wireless network to the E9-1-1 network. The NPA may be specifically provided (a full ten digit ANI), a compressed NPA or NPD may be provided (eight digit ANI), or the NPA may be derived or assumed based on the incoming trunk group to the E9-1-1 system.

Pseudo ANI

Pseudo ANI is defined as a number assigned by the wireless network system to a 9-1-1 call from a wireless device. The Pseudo ANI is generally used to identify information unique to the specific 9-1-1 call, such as cell site or cell sector of call origination. This number is typically not valid for use in reconnecting with a calling party if the original call is terminated. It does, however, generally follow the same format as a True ANI. The actual digit assignments may not follow generally accepted rules for NPAs and NXXs. The method in which the NPA information is supplied may differ depending on the network technology employed to transport the information from the wireless network to the E9-1-1 network. The NPA may be specifically provided (a full ten digit ANI), a compressed NPA or NPD may be provided (eight digit ANI), or the NPA may be derived or assumed based on the incoming trunk group to the E9-1-1 system.

ANI TRANSPORT ALTERNATIVES

The following definitions relative to Automatic Number Information delivery systems are taken from Newton's Telecom Dictionary (1992) with some additions from the WIP team for clarification within the 9-1-1 environment.

CAMA Trunking

Centralized Automatic Message Accounting, or Local Automatic Message Accounting are specific versions of AMA in which the ticketing of toll calls is done automatically at a central location for several Central Offices (CAMA) or only at the local office for that office's subscribers (LAMA).

Feature Group D Trunking

Feature Group D is the class of service associated with equal access arrangements. All IX carriers enjoy identical connections to the local exchange carrier. All customers dial the same number of digits, and can reach the predetermined IX of their choice by dialing 1 plus the telephone number being called.

ISDN Signaling

ISDN stands for Integrated Services Digital Network. This is a relatively new concept of what the world's telephone system should be. ISDN seeks to overcome traditional network deficiencies by 1) providing an internationally accepted standard for voice, data

and signaling; 2) by making all transmission circuits and end-to-end digital; 3) by adopting a standard out-of-band signaling system; and 4) by bringing significantly more bandwidth to the desk top. An ISDN central office will deliver to the user's office or factory several basic ISDN services, also called interfaces. These are BRI (2B+D "S" or "T"), PRI (23B+D or 30B+D), and SS7 (see below).

Basic Rate Interface (BRI)

The 2B+D is called the Basic Rate Interface, or BRI. The "S" Interface uses four unshielded normal telephone wires (two twisted wire pairs) to deliver two "Bearer" 64,000 bits per second channels and one "data" signaling channel of 16,000 bits per second. An S-interfaced phone can be located up to one kilometer from the central switching office switch driving it. Each of the two 64 kbps "bearer" or B channels can be used to carry a voice conversation, or one high speed data or several data channels, which are multiplexed into one 64 kbps high speed data line. The "D" channel of 16 kbps will carry control and signaling information to set up and break down the voice and data calls. The "D" channel can also carry data up to 9600 bits per second in addition to the control and signaling information, Signaling and control on the D channel conforms to a protocol (LAPD) and a messaging structure (Q.931). These two allow intelligent endpoints and switching nodes from different vendors to talk a common language and thus be able to transfer features across a network, from one switch to another, e.g. to transfer features across town through several switches and to have it arrive at the end phone with the calling party's name.

The "T" Interface delivers the same two 64 kbps bearer channels and one 16 kbps data channel, except that it uses 2-wires (one pair) and can work at 5-10 kilometers from the central office switch driving it. The B channels are designed for PCM voice, slow scan videoconferencing, group 4 facsimile machines, or whatever you can squeeze into 64,000 bits per second full duplex. The data (or D) channel is for bringing in information about incoming calls and taking out information about outgoing calls, It is also for access to slow-speed data networks, like videotext or packet switched networks.

Primary Rate Interface (PRI)

Primary Rate Interface (PRI) is 23B+D or 30B+D. At 23B+D, it is 1.544 megabits per second. At 30B+D, it is 2.048 megabits per second. The first, 23B+D, is the ISDN equivalent to a standard T-1 line in the U.S. which operates on two pairs. The second, 30B+D, is the ISDN equivalent to the standard T-1 line in Europe which also operates on two pairs.

Signaling System 7 (SS7)

Integral to ISDN's ability to produce new customer services is CCITT Signaling System 7. This is a CCITT recommendation which does two basic things: First, it removes all phone signaling from the present network onto a separate packet switched data network, thus providing enormous economies of bandwidth. Second, it broadens the information that is generated by a call, or call attempt. This information, like the phone number of the person who is calling, will significantly broaden the number of useful new services the ISDN telephone network will be able to deliver. SS7 provides two major capabilities: 1) Fast call set-up, via high-speed circuit-switched connections; and 2) Transaction capabilities which deal with remote data base interactions – what this means in its simplest terms and in one simple application is that SS7 information can tell the called party who is calling and, more important, can tell the called party's computer the same thing. The phrase "smart trunks" identifies SS7 connectivity.

LOCATION DETERMINATION

Enhanced 9-1-1 features include Automatic Location Identification or ALI. This feature provides information to a 9-1-1 call taker regarding the location the 9-1-1 call originated from. In a wireless environment, the telephones or calling devices are not fixed to wires at a static location. This situation creates the challenge of determining the location of the calling party using a wireless device to call 9-1-1. There are several electronic methods of location determination that can be employed, each providing a different level of location accuracy. The objective of location determination and ALI in a wireless 9-1-1 environment is to establish as closely as possible the location of the call origination, so that accurate call routing can be achieved and useful ALI information can be presented to the 9-1-1 call taker.

Cell Site Location

Cell Site location is defined as identifying the cellular or wireless antenna site from which the 9-1-1 call originated. This level of service is generally provided by assigning a Pseudo ANI to each antenna site. This Pseudo ANI is then forwarded by the wireless network to the E9-1-1 network when 9-1-1 is called. By pre-defining the geography of antenna coverage areas and translating Pseudo ANIs to specific antenna sites, Cell Site location provides a 9-1-1 call taker with a general area that a 9-1-1 call originated from. Some antenna sites cover areas that are several square miles in size. This level

of accuracy can be helpful to 9-1-1 call takers. However, more specific location information is desired, if available.

Cell Sector Location

Wireless antenna sites are typically divided into three or more discreet sectors. Cell Sector location is defined as identifying the specific antenna sector from which a 9-1-1 call originated. This level of service is generally provided in the same manner as Cell Site location, only Pseudo ANIs are assigned to each antenna sector, not just the antenna. By pre-defining the geographic coverage area of each antenna sector, this level of service provides more specific location information to 9-1-1 call takers than Cell Site location. However, Cell Sectors can also cover several square miles of area and even more specific location information is desired, if available.

Specific Coordinate Location

Specific Coordinate location is defined as determining the specific latitude and longitude (or X,Y) coordinates of the location where the 9-1-1 call originated. There are multiple technologies that can be integrated to a wireless network to provide this level of location determination. The specific technology deployed is not a factor in defining this service level, except that each location determination technology will have differing levels of accuracy or confidence. This level of service provides the most accurate level of location determination available.

EMERGENCY CALL ROUTING

The type of emergency call routing available for E9-1-1 is dependent on the type of location information available and the type of E9-1-1 selective routing switch being used. One assumption used in describing levels of service for emergency call routing is that the wireless network is handing off 9-1-1 calls to an E9-1-1 network or selective router. The goal in emergency call routing is to deliver a 9-1-1 call to the PSAP jurisdictionally responsible for answering 9-1-1 calls from the location the call originated, minimizing the need for call transfers where possible.

Default Call Routing

Default Call Routing is defined as 9-1-1 calls that are routed to a designated PSAP based upon the inbound trunk group. No call identification information is used in the routing decision.

Manual Call Routing

Manual Call Routing occurs when human intervention is used during the call process to route a 9-1-1 call to the appropriate PSAP. Upon receipt of the initial call, a call taker must obtain the specific location information from the calling party, ascertain the appropriate responding agency, and transfer the call. This level of service can be combined with Selective Routing that is based upon Cell Site or Cell Sector location information to ultimately deliver the call to the appropriate PSAP.

Selective Routing

Selective Routing is a set of static routing tables that direct a 9-1-1 call to the appropriate PSAP based upon the ANI received from the wireless network. (This is the same process currently used in most E9-1-1 systems for wireline services.) This level of service is generally applied when Cell Site or Cell Sector location information is provided. Manual Call Routing may be used to transfer the call to its final PSAP destination.

Dynamic Call Routing

Due to the mobile nature of wireless communications, the specific location of any given wireless device is not known until the moment that a call is placed. For 9-1-1, this means that a routing decision must be dynamically made when 9-1-1 is called. This level of service requires specific coordinate location information. Dynamic Call Routing directs a 9-1-1 call from a wireless device to the specific PSAP responsible for the jurisdictional area that the call originated from.

CALL DISPLAYS

9-1-1 call displays are used at the PSAP to present information regarding 9-1-1 calls to the call takers. This information has historically been presented in a text format on various screen types and formats. Due to the mobile nature of wireless communications devices, display of 9-1-1 call information to calltakers requires some modifications. Most industry experts agree that providing a graphic display of location information for calltakers will allow for the most efficient and prompt determination of a callers location.

Textual Information Display

This feature provides caller information in a textual format. The content of the information can vary from simply identifying the call as originating from a wireless device to providing closest known address or landmarks and subscriber information. The specific content displayed is dependent on the display device used and the availability of information from the E9-1-1 network and/or ALI systems.

Graphic Information Display

This feature provides graphic map images to a call taker with information or overlays that indicate the location or area a call originated from. The detail available in a graphic map can vary from including simple street centerline files to detailed orthographic mapping highlighted with major landmarks. The accuracy and detail available in this level of service is dependent on the map base or geofile used, the type of graphic map display, and the availability of information from the E9-1-1 network and/or ALI systems.

Other considerations with regard to graphic display of location information relate to the continual maintenance of the base map, spatial accuracy and relative placement of symbols on the base map, and cognitive factors affecting the attendant's knowledge of the mapping tool (navigation, maneuvering, scaling, etc.) within the mapping software.

PHASE I

Test Plan

The Texas Wireless Integration Project (WIP) was designed to be closely aligned with the Federal Communications Commission's mandate to allow for the delivery of wireless telephone calls to 9-1-1. In June of 1996, the Commission required that 9-1-1 calls placed from commercial wireless telephone subscribers be delivered to Public Safety Answering Points (PSAPs) without being blocked or screened for subscriber validation or economic charges. Wireless carriers were also charged with delivering to the 9-1-1 system the caller's call-back telephone number and an additional number, identifying the "cell" tower or antenna that relayed the 9-1-1 call. The deadline for compliance was set as April of 1998. A few members of the Texas WIP team worked with national public safety agencies, wireless industry representatives and FCC officials to craft the requirements called for by the Commission's Notice of Proposed Rulemaking. It was widely held in Texas that a concerted effort was the best effort in bringing about solutions quickly and with majority consensus.

The Texas WIP demonstrated the technological feasibility of the FCC mandate and further expanded its scope to better underscore the true spirit of the order, which was to enhance the ability of the emergency call-taker to locate and effect a response to a 9-1-1 caller using a wireless telephone. To demonstrate that a call-taker can be more effective in locating and assisting a citizen in need given additional pieces of data, the WIP team incorporated several components.

The goal of the WIP team was to acknowledge the limitations of and to exploit the merits of available technology to better equip the call-taker to focus their attention into specific areas, rather than wholly rely on the caller's awareness of, and ability to communicate a description of their surroundings.

The Texas WIP demonstrated one of several ways to accomplish the goal at hand. We didn't set out to carve the road map in stone, but to suggest an open minded approach to applying currently available technology in a *coloring-outside-the-lines* approach to solve a problem.

Description:

The nationally prevalent infrastructure of 9-1-1 is built on 1950's signaling technology and carries with it some inherent limitations. The delivery of a wireless 9-1-1 call in today's environment is based on modified replication of default routing schemes whereby calls are delivered based on static information, such as originating wire center (the caller's serving central office), and additional subjective data. Most current implementation schemes call for grouping of cell sites into geographically divided areas for default routing to the most appropriate PSAP. The primary example would be to route all 9-1-1 calls from cell towers, whose collective coverage areas lie within a particular community's boundaries, to a specific PSAP within that community, unlike the wireline infrastructure where calls are routed automatically to the jurisdiction that serves the location of the caller.

Radio waves from wireless transmitters have no respect for political jurisdictions and their call routing boundaries. Considerable subjective data must be applied to create these routing schemes based on knowledge of land use, vehicular traffic patterns, population density and human judgment. Because of radio frequency propagation, directed retry from congested cell sites, and other RF anomalies, calls may not be routed initially to the appropriate PSAP and therefore may require manual redirection.

A project demonstration area was selected on the west side of metropolitan Houston. The area was selected because of the presence of several political subdivisions, as well as its urban terrain, population density and transportation thoroughfares. Seven cell sites were identified within the test area, comprised of approximately twenty-one (21) cellular sectors, or RF coverage areas.

The Greater Harris County 9-1-1 Emergency Network's (GHC) computer telephony lab was used to simulate two test PSAPs. GTE Mobilnet was the participating wireless carrier for phase one of the WIP, contributing use of one of their Lucent 5E mobile switches. The team established dedicated network facilities between GTE's cellular switch and the Network's lab. Southwestern Bell provided a T-1 circuit and by using the common multi-frequency signaling protocol known as Feature Group D (FGD), GTE's Mobile switching center (MSC) could pass called number identification and calling number identification to GHC's digital switch. The GHC switch was a NORTEL Meridian One, Option 61C. The use of feature group D to pass two telephone numbers replicated, in a fashion, standard call delivery practice from a local exchange carrier (LEC) to an inter-exchange carrier (IXC).

Delivery of the calling number was accomplished via standard Calling Line Identification (CLID) as passed by the MSC, and represented the public switched telephone network (PSTN) dialable number for that mobile station (cellular phone). Additionally, the MSC performed an internal translation from the called number of 2-1-1 to a unique predetermined ten-digit identification number associated with the cell site and sector (base station) from which the call originated. This identification number translation was based on the origination code provided by the base station to the to the MSC and is known as "pseudo-ANI".

To provide isolation from, and prevent disruption of normal primary emergency call processing activity, the emergency dialing digits used were 2-1-1. Calls were placed to the aforementioned test PSAPs which were manned by trained technical personnel, operating under standard project guidelines and procedures. To demonstrate compatibility with the existing embedded 9-1-1 infrastructure, 2-1-1 calls were moved about (conferenced or transferred) in the public switched network via standard 9-1-1 tandem switching features or the 9-1-1 Network's digital switching features.

The GHC 9-1-1 Network utilized their NORTEL Meridian 1, Option 61C digital PBX switch. This switch is networked, via Digital Equipment Corp.'s (DEC) computer integrated telephony interface and NORTEL's Meridian Link ®, to a host computer. The host computer system is a series of networked DEC Alpha Servers running Microsoft's NT Advanced Server® operating system and Network developed CIT software.

The calling party's telephone number was passed to the Network's digital switch as CLID. Upon receipt of routing instructions from the Networks host computer CIT software, the switch delivered the voice component and the CLID to the appropriate call-taker position, as described below. The CLID was displayed at the call-taker position as ANI. The call-taker equipment consisted of integrated PC workstations running NORTEL's VISIT ENR software.

The translated called number, or pseudo-ANI, was accepted by the Network's digital switch and passed to the Network's host computer. The host interpreted this as an identification number representing the delivering cell sector. The host computer compared the delivering cell sector identifier to the geospatial database and determined the appropriate geo-political jurisdiction(s) responsible for that cell site's coverage area.

The host (server) then passed routing instructions to the Network's switch which then routed the call to the appropriate PSAP. This was done in much the same manner as the subjective routing utilized in the embedded infrastructure. Voice and calling number information (ANI) were presented to a display telephone set at the attendant workstation via digital connections.

The host computer passed data to the attendant's workstation that allowed for the display of a graphical map depicting the cell sector's RF coverage area (as supplied by the wireless carrier's RF engineering personnel). This could also include additional stored data concerning that geographic area (hazardous waste, schools, hospitals, nursing homes, etc.). The map could be manipulated to account for sector identification errors such as directed re-try or propagation anomalies.

The ability to plot coordinates on an electronic map is relatively taken for granted. Having a firefighter or paramedic arrive at the exact location of an emergency incident based on the map's depiction of the incident's coordinates, can pose problems if base maps and coordinates collected in the field are not synchronized. The wealth of technology and systems integration applied toward the Texas WIP would be of little value without a true understanding of spatially accurate data and the application thereof in public safety. Laser sighting devices pinpointing caller location within centimeters is completely useless when mapping systems are bsed upon spatially inaccurate data. More information on spatial correction is provided later in this document

Test Architecture

Variables included in the first phase of the WIP trials included Network Intelligence, Data Transport, Location Technology, Data Management, Call Routing, and PSAP CPE considerations. Each of these variables as configured for Phase I are documented following the diagram of Phase I architecture on the following page.